

"Larry Roberts"
August 15, 1994/Tape Number Two
-- CARIBINER GROUP

(OFF MIKE)

QUESTION

Tell(?) me(?) about the first four sites.

LARRY ROBERTS

Well, the first four sites were, uh, the first sites that the Arpanet would be, uh, connected to was a difficult decision. Uh, we knew we needed to have something on the order of four in order to make it a good test. There ... we had a whole collection of sites identified, probably at least fifteen, that we knew we were going to(?) try to connect to. Um, but many of those sites were, um, uncooperative to begin with. Um ... they ... like Minsky at MIT. He didn't allow(?) his machine to be used by anybody else, let alone all these people all over the country who were going

to take his time away. So he didn't want anybody else to touch his machine. And so we couldn't do that. The same was true at Stanford with the McCarthy and so on. So that ... those artificial intelligence people had a very, very, uh, high view of ... of the need for their machine. And we couldn't touch theirs to begin with. Uh, they came around very quickly thereafter. As they got on the network they found that it was very valuable, but ... initially was(?) a lot of people like that who found it very difficult. So there was a ... there(?) was only a small set of sites where it was going to be, um, compatible with, uh, things(?) now. In addition, we had some particular requirements. We needed to have the testing started immediately. The network testing. So Kleinrock at UCLA was a ... was a must. And probably the only one that was a ... absolute must. Because, uh, he was going to do all of the testing of the network.

And the network meddling(?) to figure out whether this ... what ... what the theory was behind this. And the c.. and make it work for us in the future. Then, secondly, Engelbart was ... had the resource center. And we wanted to get that on line as soon as possible. And get that rolling. So that we would have the document center on ... on line. And, uh ... then ... at the University of Utah they were very compatible and very supportive. Ivan was there from ... from the government(?) on(?) the previous time. And was, um, supporting it(?), locally. And we had ... we had a very cooperative group at ... at Utah. And so that was ... that was, uh ... effective. And the Santa Barbara was also the same type of very cooperative and supportive. And that(?) was all local enough that we could do it within expensive communications. We didn't run(?) across the country at the original time. So starting with UCLA and looking at then

SRI(?) then we took on the other two as being the closest sites that ... that could support us. Without a lot of machine difficulty. Because we didn't want a lot of different machine types too, if we didn't have to have it. Beyond the first several. So it was ... it was a ... a very ... um ... selecting down from that list. And then it grew from there as fast as we could grow it.

QUESTION

It ... that ... that's really interesting. You said that you kept communications inexpensive? Uh, by ... keeping it, uh ...

(OFF MIKE)

QUESTION

... uh, what ... talk a little more about that. Like what kind of issue was expense in those days? Because these days we don't really think about it.

LARRY ROBERTS

Well, they ... we had decided to use fifty s..

kilobit(?) lines. Fifty kilobit lines were the most expensive thing that the government ever heard of. And(?) then(?) these were huge, uh, wide(?) band(?) with channels to dominate(?) were very expensive. And they used actually a lot of, uh, of ... they were very expensive, um, from the telephone company. So ... we undertook to do that very judiciously to build it up until we could prove that we had a case that it was going to be more economic than anything else. In the long run, we proved that the communications cost was maybe, uh ... a third to a tenth of the communic.. the computer cost we saved. So we saved more money in computing than we did spend in(?) communications to do the job. But in the short run we had prove that. And we had to use the money wisely. I had started with fifty kilobit lines because I believed that it was as important ... I has met with, um, the people from the U.K., um ... Donald Davies, who had

been working on packet(?) switching in the U.K. for many years before this. And, um, he had convinced me when ... when we first got together in nineteen sixty-seven that we shouldn't go with lower speed lines. We should go with fifty kilobit lines because, uh, the delay would be so large that we wouldn't prove our point. We wouldn't do(?) the right experiment. And we could have a cheaper thing overall if we had less lines at higher speed. And, so I worked that out. And it looked like it was true. But we couldn't ... still we couldn't go too far too fast. And then ... and then the lines did cost a lot of money. And they were a good part of the budget. I mean in fact the most ... the entire cost of network to the government at that time was the lines. Not the machines. The switches.

QUESTION

Len told the ... funny story ... I think it was Kleinrock saying, uh, somebody banged on the

table and said, "I want a ... less than a second response." Do you remember anybody banging on the table (Inaudible) at(?) that?

LARRY ROBERTS

(Clears Throat) I don't know.

QUESTION

Do you remember him(?) talking about that?

LARRY ROBERTS

I don't know about anybody in particular ... uh ... particular to me. As(?) far(?) as(?) response time. But I do know that almost everybody was ... feeling that ... uh, whatever happened ... whatever interaction happened, had to happen within ... within a second because that's the human response time in order to not be, um ... falling asleep doing something else. Or having ... changing your mind to do something else. If ... if you can get a response to anything you're(?) doing within a second, then you keep your mind on that thing. And so ... it was critical from a

human factors(?) perspective to do that. If we were going to have, uh, an effective communications vehicle. Whether it was for messaging or for, um, a response to a computer interaction or anything.

QUESTION

Uh, we're asking everyone this question. Which is, uh ... did you have any idea how ... when you started this, what it would turn into?

LARRY ROBERTS

Well, my idea when we started was probably, um, more along the lines of what is happening now than what was happening in the interim. That is, what happened, uh ... initially was that I ... was conceiving of, uh, information sharing ... document sharing ... um, computer sharing ... throughout the world as being, um ... the primary thing. That people could inter.. interact with resources. And ... and get at the resources on other machines. Which is what they're doing

today with Mosaic and other, uh, things that ... they've(?) been getting out the resources of other systems. Um ... what happened in the ... in ... short term in Arpanet is we started doing the research and developing the protocols and the techniques. And then in nineteen seventy-one we introduced the tip(?). And people started doing local access to get on and off(?) machines. And so there was a lot of essentially time sharing access to get at remoter(?) machines. To provide access to a lot of people that didn't have access. And that was something which was a big factor in the Arpanet activity for many years. And now, of course, is non-existent. Because we don't have time sharing users anymore. Everybody had their own machine. Whether it's a PC or something else. And so it's back to what it was originally in(?) the concept of a lot of people with machines. They happen to be small machines, but still much more powerful than we

had then. Um, every PC is more powerful than any machine we had on the net to begin with. And the, um, result is that all those people can interact and share resources and ... and do.. document some ... and information. And that's probably, um, the ... the biggest factor that has come around. Now and(?) E-mail has been a constant throughout that whole period. But ... but, um, the biggest thing is that it has turned out more like I was thinking now. But much slower than I thought. I mean I thought that would happen in a ... faster period of time. Um, until I started studying the trends. And then I realized it was going to take this long. And in fact I also predicted that ... we would in fact be ... uh, in eighty-one I got up at a speech when I won the Erickson award, um ... in Sweden. And when I gave the speech to the National Academy, I said we're ... it's going to be another twenty years before voice turns over to

packetnets(?). We get fast packet ... you know, the ... the ATM type technology in place. And voice turning over and switching. Well, that was in eighty-one. And in two thousand and one I think we will get to about the point where voice will start switching over to ATM and being used ... we'll the use packetnetwork for voice. In the meantime, uh, in the next couple of years ... in about nineteen eighty ... ninety-seven or six or seven, we'll start having voice between corporation entities on the network. Uh, and then we'll start going to where in fact voice will be more extensive. But it took ... it takes a long time. Because even though it was economic in eighty-one ... and it was clearly economic then ... it's not going to be, uh ... it takes a long time for that change to occur after the economics are clear. And the same was true back on the Arpanet. When the Arpanet started, it was already ... uh, very clear that it was much

cheaper to do, uh, packet switching than circuit switching. If you look at the economics. I mean, my papers show that it was probably four or five times cheaper already in ... in nineteen eighty-nine. But ... I mean in nineteen sixty-nine. But then it still another ... uh ... ten years or so for the industry to ... to take off and have this really be an industry of any kind. And twenty years or ... or twenty-five to where it's really a major activity. Um ... and it ... it takes a lot of time for that to grow. And for people to put in the systems and then develop the technology and ... and the pieces and then ... then put it in place. Particularly within the communications industry.

QUESTION

Uh, what ... can you talk a little bit about, um, what you're doing now with ATM and how you have sort of this feeling of deja vu with the, uh ... some of the technical (Inaudible).

LARRY ROBERTS

Well the ATM industry today is ... is actually in a very similar place to where the Arpanet was back in nineteen seventy-one. We, um ... we are working on the ... the final pieces of technology for ATM. Uh, flow control, for example, is the ... is the ... the latest and the most controversial of all things within the standards to occur so far. And is critical for ATM to be functional for data communications. ATM has been designed to support both video, voice, and data. And video and voice we've sort of handled by allocated van(?) widthins(?) so you can buy so much ... by contract. But ... but for data we need to have flow control. And to do that, we need to have a scheme which is now being designed. It's a ... it's, uh, extremely controversial. There's a group of people who want to do it the way we did it back in Arpanet. Which is to use credits and pass out credits, uh, for flow control. And

there's a group of people who want to do, uh, rate(?) assignments. So you can ... so can assign rates to the people and say go at this rate. And that's become one of the most controversial and ... and argumentative things around. But the excitement and the level of interaction that goes in tremendous. With ... at the ATM forum meetings now, which happen every, uh, two months, the, uh ... people are as excited and as ... and moving as they were back in seventy-one. And the level of papers on E-mail that are going out, I mean the ... the ... flurry of ... of activity and research and simulation(?) and design is ... at the level of heights that I haven't seen it ... s.. in twenty years. Um ... and, it's very exciting. Because it's happening all over again. And people are finishing, uh, design of what is now going to take over all of communications technology. Not just data. And ... and get the ATM networks out there to really support us in

the future. So it's ... it's a major ... an ... uh, activity at the moment. And it's very exciting to be part of it.

QUESTION

Well, I have to ask you this. Did you ... uh, twenty-five years ago think that today in nineteen ninety-four, you would still be in networking?

LARRY ROBERTS

Well, twenty-five years ago, I wasn't sure what I would be doing (Laughs) at this point. Because I had been in graphics. And I had been in data compression and I had been in lots of fields by then. So I had changed fields a lot of times by then. And so I wasn't sure ... whether(?) I wouldn't keep doing that I guess. But, um ... I did find it very valuable to stay in communications and ... and move on with it. I certainly didn't think I would be doing the level of technical activity I am today. Um ... over time

I m.. I evolved like most people to more and more management and less and less technical. Until I started, um, really getting the right foods and supplements in my diet so that I could ... my brain could work again like it used to. And now I can operate the same as I did when I was thirty. And so I'm able to operate and ... and do just like I did. And so ...

QUESTION

Tell(?) us(?) your secret ...

LARRY ROBERTS

(Laughs)

QUESTION

(Overlap) what ... tell us your secret. What's your diet?

LARRY ROBERTS

Oh, there's a whole collection of ... of, um ... of ... of what you call smart drugs that you can take which are ... are supplements to your diet. Which enhance your intelligence and let your

brain work like it used to. And it ... your brain ... your chemistry of your body dies over time to where you don't digest your food properly and get the right nutrients into your brain. And so it doesn't work right. And you can supplement that very easily. But ... you know, I ... I don't want to go into all of the details. It's a long conversation.

QUESTION

Later on we'll want you to write all this out for
(Overlap)

(OFF MIKE)

(CUT)

(OFF MIKE)

QUESTION

Uh, thinking again back ... then you ... you chose BBM(?) to ... for this contract. What was that really based on over ... I'm sure there were some other good proposals that (Inaudible)

LARRY ROBERTS

Well, what(?) I ... what I ... when I, um, compared the bids for the Arpanet I ... I really wanted to find an organization which would, uh, put tremendous amount of technical, uh, energy into it. And do it very quickly and very rapidly, uh, and very effectively and ... and ... and design the right network. So I wanted it ... the hottest and ... and sharpest group I could find. Making the selection was difficult but, uh, there were a lot of companies who put themselves out of the bidding. Like a number of the big computer companies no-bid because they didn't think we could ever find a computer small enough to do it. And, uh, so ... they were easy to get rid of. They ... they said no. Some of the, uh ... there were a lot of very good bids though. And many people chose the same kind of mini computer that BBM chose to do the job. And, um ... the big thing about BBM was that it had, uh, a very ... uh ... low, uh ... tear(?) group, if ... if you will.

In other words, the ... the management structure was not anywhere near as deep as some of the other structures. And what(?) I(?) saw(?) was a lot more technical people closer to the surface who could, in fact, m... you know, work on the job. And under ... the group under Frank Hart(?) was just structured in a way that I would work a lot better and a lot faster. It had a lot smarter people than some of the others. And what I saw in their proposal was a lot more work on some of the details and ... and showing that they had that technical, uh, interest and ... and strength to make it happen. The way we needed it to happen. And so I saw that we had a very sharp group with the ... the over, uh ... structuring of management layers. And one that could do the job quickly. And that's really the distinction. Otherwise there were other people who rated almost identical.

(OFF MIKE)

QUESTION

This ... this might make a good little sound bite. Is ... uh, to say that, uh ... you know, some people, uh, didn't think there was a computer small enough to ... I mean, we(?) could isolate that?

QUESTION .

Sure. Um ... I mean that's just something we're going to want you to say.

LARRY ROBERTS

Well, it ... it ... the ... the ... the interesting thing about the ... the bidding process with these large computer companies, IBM and CDC(?) in particular, was they ... they didn't believe it was possible to do this. Because they didn't have a computer ... a small computer. They didn't believe that, uh, small computers were feasible. And we said we wanted this all in a box. And we wanted the price to be reasonable. And there was no way they thought was(?) possible.

So they no-bid. It was, um ... it was ... um, very surprising in a lot of respects that they ... they couldn't find any way to do it. Or couldn't use anybody else's mini computer. Or something else. But ... uh, the big companies didn't really find a way to compete very effectively.

QUESTION

Okay. The last question I'm going to have is ... is I'm going to ask you (Inaudible) a ... a critic at this point. And I'm going to ask you to comment on Len Kleinrock's poetry.

LARRY ROBERTS

Which poetry?

QUESTION

Okay. Uh ... maybe you don't ... maybe this(?) is an imperfect question. Len Kleinrock wrote a whole bunch of what was ... I think dubbed "bad poetry." Uh, and it became something that got passed, uh ... around over the network, uh ... quite a lot. I don't ... maybe you don't know

about it. And I thought ... we that it ... if we
just threw that at you and you were family or
something (Overlap)

LARRY ROBERTS

No. I'm not going to get. They'll ...

QUESTION

(Overlap) you had been(?) ... his thing Act One or
Act ...

LARRY ROBERTS

Yes.

QUESTION

Um ... he read this poem called the Big Bang. Uh
... do you remember that?

LARRY ROBERTS

I remember him being there. But I don't
remember the poem. (Laughs)

QUESTION

Oh. Okay.

LARRY ROBERTS

So I'm sorry.

QUESTION

That's all right. Uh ... I ... think we're there.

(OFF MIKE)

(END OF TAPE TWO)